

REMARKS

The above amendment is submitted to place the specification and claims in substantially the same conditions as to the claims which have been amended under Article 34 in the international application, correct typographical errors in the specification and remove multiple dependency in the claims. An English translation of the annexes of the PCT international preliminary examination report is enclosed. Early and favorable action is awaited.

Attached hereto is a marked-up version of the changes made to the specification and claims by the current amendment. The attached page is captioned "Version with markings to show changes made."

In the event there are any additional fees required, please charge our Deposit Account No. 01-2340.

Respectfully submitted,

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Enclosures: Substitute sheets

VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE TITLE:

The title of the specification has been amended as follows:

ELECTRIC DEVICE [AND APPARATUS FOR CHARGING BATTERY UNIT,]
AND METHOD FOR CHARGING AND DISCHARGING BATTERY UNIT OF
THE SAME

The invention relates to an electric device such as an electric vehicle of an electric bicycle, an electric wheelchair, or the like using electric energy by a battery as a power supply, an apparatus for charging a battery unit thereof, and a method for charging and discharging the battery unit.

IN THE SPECIFICATION:

The paragraph beginning at page 1, line 7, has been amended as follows:

The invention relates to an electric device such as an electric vehicle of an electric bicycle, an electric wheelchair, or the like using electric energy by a battery as a power supply [, an apparatus for charging a battery unit thereof,] and a method for charging and discharging [the] a battery unit of the electric device.

The paragraph beginning at page 2, line 8, has been amended as follows:

A conventional electric device using a storage battery pack as the storage battery and a method for charging the storage battery pack are explained here using FIG. 15 to FIG. 20B.

The paragraph beginning at page 3, line 26 and ending at page 4, line 8, has been amended as follows:

On the other hand, electric devices 300, 310 and 320 shown in FIGs. 18[(A)]A, 19[(A)]A and 20[A]A have no charging apparatuses thereon, and charging apparatuses 301 respectively shown in FIGs. 18[(B)]B, 19[(B)]B and 20[(B)]B are provided at a garage or a rest area. Each battery section 302 in FIG. 18, FIG. 19A or FIG. 20A is composed of storage battery packs 302a or storage battery pack units 302b as in the battery section 202 in FIG. 15, FIG. 16 or FIG. 17, but is a unit attachable/detachable to/from the main body of the electric device 300, 310 or 320 and provided with connectors 306a and 306b for establishing electrical connection to the main body. The other structures are the same as in the electric devices shown in FIG. 15 to FIG. 17.

The paragraph beginning at page 4, line 9, has been amended as follows:

When charge is performed for the battery section 302 detachably mounted on the electric device 300, 310 or 320, the charge is performed by detaching the battery section 302 from the device main body and moving and installing it in the charging apparatus 301 which is separately placed and connected to the commercial power supply 100 as shown in FIG. 18[(B)]B, FIG. 19[(B)] B or FIG. 20[(B)]B.

The paragraph beginning at page 5, line 17, has been amended as follows:

Furthermore, as for the battery section, when the battery section is constituted by connecting in parallel a plurality of storage battery packs or storage battery pack units as in the above-described electric device shown in FIG. 16 and FIG. 17 or FIG. 19A and FIG. 20A, it is required to limit variation in charge amount to within an allowable range or to provide means for controlling it so as not to produce the variation among the storage battery packs or the storage battery pack units.

The paragraph beginning at page 16, line 19, has been amended as follows:

FIGs. 18[(A)]A and 18[(B)]B are block diagrams showing an example of a charge state of the storage battery pack by a charging apparatus which is provided separately from the conventional electric device on which the storage battery pack is mounted;

The paragraph beginning at page 16, line 23, has been amended as follows:

FIGs. 19[(A)]A and 19[(B)]B are block diagrams showing another example of a charge state of the storage battery packs by a charging apparatus which is provided separately from the conventional electric device on which the storage battery packs are mounted; and

The paragraph beginning at page 16, line 27 and ending at page 17, line 3, has been amended as follows:

FIGs. 20[(A)]A and 20[(B)]B are block diagrams showing still another example of a charge state of the storage battery packs by a charging apparatus which is provided separately from the conventional electric device on which the storage battery packs are mounted.

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IN THE CLAIMS:

The following claims have amended as follows:

4. (Amended) An electric device, comprising:

a plurality of battery units detachably mounted thereon, each battery unit constituted by pairing a storage battery pack with a memory for storing at least information about charge and discharge states of the storage battery pack;

connectors provided on said each battery unit and a battery unit installation section on a device main body side, for performing electrical connection/disconnection to/from the device main body side incident to attachment/detachment of said battery unit; [and]

a driver for driving a load, [a charger for charging said storage battery pack by referring to the information stored in said memory of said each mounted battery unit,] and a controller for controlling supply of electric power from said each battery unit to said driver by referring to the information stored in said memory of said each mounted battery unit, which are provided on said device main body side; and

a charger for charging said storage battery pack by referring to the information stored in said memory of said each battery unit, which is provided on said device main body side or in said each battery unit,

wherein said charger includes means for reading at least an information about charge and discharge states of the storage battery pack stored in said memory of said each battery unit, and means for writing into said memory at least the information about charge and discharge states of said storage battery pack in the same unit.

5. (Amended) An electric device according to claim 4, [comprising:

a plurality of battery units detachably mounted thereon, each battery unit provided with a storage battery pack, a memory for storing at least information about charge and discharge states of the storage battery pack, and a charger for charging said storage battery pack;

connectors provided on said each battery unit and a battery unit installation section on a device main body side, for performing electrical connection/disconnection to/from the device main body side incident to attachment/detachment of said battery unit; and

a driver for driving a load and a controller for controlling supply of electric power from said each battery unit to said driver by referring to the information stored in said memory of said each mounted battery unit, which are provided on said device main body side,]

wherein said charger is provided in said each battery unit, and said charger [of said each battery unit] has means for deciding a charge order by mutually referring to the information stored in said memory of said each mounted battery unit.

6. (Amended) An electric device according to claim 4, [comprising:

a plurality of battery units detachably mounted thereon, each battery unit provided with a storage battery pack, a memory for storing at least information about charge and discharge states of the storage battery pack, and a switch connected to said storage battery pack in series;

connectors provided on said each battery unit and a battery unit installation section on a device main body side, for performing electrical connection/disconnection to/from the device main body side incident to attachment/detachment of said battery unit; and

a driver for driving a load, a charger for charging said storage battery pack through said switch by referring to the information stored in said memory of said each mounted battery unit, and a controller for controlling supply of electric power from said storage battery pack to said driver through said switch of said battery unit by referring to the information stored in said memory of said each mounted battery unit, which are provided on said device main body side]

wherein a switch connected to said storage battery pack in series is provided in said each battery units,

said charger is means for charging said each storage battery pack through said switch by referring to the information stored in said memory of said each battery unit and provided on said device main body side, and

said controller is means for controlling supply of electric power from said storage battery pack to said driver through said switch of said each battery unit by referring to the information stored in said memory of said each battery unit.

7. (Amended) An electric device according to claim 4, wherein

said charger is constituted to be a unit attachable/detachable to/from said electric device main body, and is provided on said device main body side.

10. (Amended) An electric device according to [any one of] claim 4 [to claim 8], wherein

said controller has means for reading the information stored in said memory of said each battery unit to control action of the whole device.

11. (Amended) An electric device according to [any one of] claim 4 [to claim 8], wherein said memory of said each battery unit also stores information about characteristics of said storage battery pack, and said charger has means for controlling charge of said storage battery pack, by referring to the information about the characteristics of said storage battery pack stored in said memory of said each battery unit, in accordance with the characteristics.

12. (Amended) An electric device according to [any one of] claim 4 [to claim 8], wherein said memory of said each battery unit also stores information about characteristics of said storage battery pack, and said controller has means for controlling discharge from said storage battery pack, by referring to the information about the characteristics of said storage battery pack stored in said memory of said each battery unit, in accordance with the characteristics.

13. (Amended) An electric device according to [any one of] claim 4 [to claim 8], wherein said controller has means for displaying a remaining capacity of said storage battery pack of said each battery unit based on the information stored in said each battery unit, and displaying a charge request and/or giving an alarm when a storage battery pack needing to be charged exists.

16. (Amended) A method for charging and discharging [said] a battery unit in [the] an electric device [according to any one of claim 4 to claim 8] comprising: a plurality of battery units detachably mounted thereon, each battery unit constituted by pairing a storage battery pack with a memory for storing at least information about charge and discharge states of the storage battery pack;

a driver for driving a load; a controller for controlling supply of electric power from said each battery unit to said driver; and a charger for charging said storage battery pack of said each battery unit,

comprising the steps of:

discharging in order the storage battery packs of said respective mounted battery units [to a predetermined remaining capacity], and then charging them by said controller and said charger, by referring to the information stored in said memories; and

writing into said memory at least the information about charge and discharge states of said storage battery pack in the same battery unit.

17. (Amended) A method for charging and discharging [said] the battery unit in the electric device according to [any one of claim 4 to] claim [8] 16, [comprising the steps of:] wherein the step of discharging and charging is a step of discharging the storage battery packs of said respective mounted battery units in decreasing order of remaining capacity, and charging them in increasing order of remaining capacity, by said controller and said charger, by referring to the information about charge and discharge states stored in said memories.

18. (Amended) A method for charging and discharging [said] the battery unit in the electric device according to [any one of claim 4 to] claim [8] 16, [comprising the steps of:] wherein the step of discharging and charging is a step of discharging the storage battery packs of said mounted battery units in increasing order of remaining capacity, and charging them when the

remaining capacities become a predetermined value or less, by said controller and said charger, by referring to the information about charge and discharge states stored in said memories.

19. (Amended) A method for charging and discharging [said] the battery unit in the electric device according to [any one of claim 4 to] claim [8] 16, further comprising the steps of:

selecting one or more of said battery units by said controller and said charger by referring to the information about charge and discharge states stored in said memories; and

selecting remaining one or more of said battery units by said controller and said charger by referring to the information about charge and discharge states stored in said memories, and wherein

the step of discharging and charging is a step of [and] discharging each of storage battery packs [thereof] of former selected battery units, [and selecting remaining one or more battery units,] and charging each of storage battery packs [thereof] of latter selected battery units, by said controller and said charger, by referring to the information about charge and discharge states stored in said memories of said mounted battery units.

(8) To make it possible to use even different types of storage battery packs in combination.

(9) To facilitate charge by placing the charging apparatus at a battery station and to make it possible to recognize the charge and discharge states of the battery section at a high accuracy even when it is detached from the electric device so as to enable an optimal charge control.

Further, to recover the regenerative electric power from a load side such as a motor or the like to the battery section so as to utilize it efficiently.

10 DISCLOSURE OF THE INVENTION

To achieve the above-described objects, the invention provides an electric device and a charging apparatus for charging a battery unit thereof, and a method for charging and discharging the battery unit as follows.

The electric device according to the invention comprises: a plurality of battery units detachably mounted thereon, each battery unit constituted by pairing a storage battery pack with a memory for storing at least information about charge and discharge states of the storage battery pack; and connectors provided on each battery unit and a battery unit installation section on a device main body side, for performing electrical connection/disconnection to/from the device main body side incident to attachment/detachment of the battery unit.

Additionally, a driver for driving a load, a charger for charging the storage battery pack by referring to the information stored in the memory of each mounted battery unit, and a controller for controlling supply of electric power from each battery unit to the driver by referring to the information stored in the memory of each mounted battery unit, which are provided on the device main body side, and the charger includes means for reading at least the information about charge and discharge states of the storage battery pack stored

information about charge and discharge states of the storage battery pack stored in the memory of each battery unit, and means for writing into the memory at least the information about charge and discharge states of the storage battery pack in the same unit.

- 5 Here, the storage battery pack includes various types of secondary batteries such as a nickel-cadmium battery and a nickel metal hydride battery. The memory is a nonvolatile memory such as an EEPROM, a flush ROM, a RAM backed up by a battery, or the like, into which various kinds of information is written which includes at least the information about charge and
- 10 discharge states of the storage battery pack by the charger or the controller provided in the battery unit or on the electric device main body side. In addition, the information of the type and characteristics of the storage battery pack can also be written into them in advance.

- As for this battery unit, the charge and discharge states of the storage
- 15 battery pack included therein can be recognized precisely by referring to the information stored in its memory even when it is mounted on the electric device or it is detached therefrom to be in a single state, and thus an appropriate charge and discharge control can be conducted all the time.

- The electric device may comprise: a plurality of battery units detachably
- 20 mounted thereon, each battery unit constituted by integrating a storage battery pack, a memory for storing at least information about charge and discharge states of the storage battery pack, and a charger for charging the storage battery pack; connectors provided on each battery unit and a battery unit installation section on a device main body side, for performing electrical
- 25 connection/disconnection to/from the device main body side incident to attachment/detachment of the battery unit; and a driver for driving a load and a controller for controlling supply of electric power from each battery unit to the

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driver by referring to the information stored in the memory of each mounted battery unit, which are provided on the device main body side.

In this case, the charger of each battery unit has means for deciding a charge order by mutually referring to the information stored in the memory of
5 each mounted battery unit.

Further the electric device may comprise: a plurality of battery units detachably mounted thereon, each battery unit constituted by pairing a storage battery pack with a memory for storing at least information about charge and discharge states of the storage battery pack, and provided with a switch
10 connected to the storage battery pack in series; connectors provided on each battery unit and a battery unit installation section on a device main body side, for performing electrical connection/disconnection to/from the device main body side incident to attachment/detachment of the battery unit; and a driver for driving a load, a charger for charging the storage battery pack through the
15 switch by referring to the information stored in the memory of each mounted battery unit, and a controller for controlling supply of electric power from the storage battery pack to the driver through the switch of the battery unit by referring to the information stored in the memory of each mounted battery unit, which are provided on the device main body side, and the charger may include
20 means for reading at least the information about charge and discharge states of the storage battery pack stored in the memory of each battery unit, and means for writing into the memory at least the information about charge and discharge states of the storage battery pack in the same unit.

With these electric devices, a plurality of battery units can be
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detachably mounted thereon, and one or more battery units suitable for discharge can be selected based on the information about charge and discharge states of the storage battery packs stored in the memories provided in the battery units to allow them to discharge so as to supply electric power to the driving
5 section.

Also in the case of charging the storage battery packs of the battery units, the charge can be selectively performed, while an optimal control is being conducted, for a single or a plurality of battery units by the charging apparatus provided on the device main body side, the charging apparatus provided in each
10 battery unit, or the charging apparatus provided at a charger station based on the information about charge and discharge states of the storage battery packs stored in the storage apparatus in the battery units.

In these electric devices, the charger which is provided separately from the aforementioned battery unit can also be structured to be a unit
15 attachable/detachable to/from the electric device main body, so that the charger (charger unit) can be detached, together with one or more battery units, from the electric device to charge the storage battery packs of the battery units..

Furthermore, it is desirable that the controller has means for reading the information about charge and discharge states of the storage battery pack stored
20 in the memory of each battery unit and holding it therein, and means for controlling action of the whole device based on the information stored in

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the former means.

Moreover, it is possible that the memory of each battery unit also stores information about characteristics of the storage battery pack, and the charger has means for controlling charge of the storage battery pack, by referring to the
5 information about the characteristics of the storage battery pack stored in the memory of each battery unit, in accordance with the characteristics.

Further, it is suitable that the controller has means for controlling discharge from the storage battery pack, by referring to the information about the characteristics of the storage battery pack stored in the memory of each
10 battery unit, in accordance with the characteristics.

Further, in these electric devices, the controller desirably has means for displaying a remaining capacity of the storage battery pack of each battery unit based on the information stored in each battery unit, and displaying a charge request and/or giving an alarm when a storage battery pack needing to be
15 charged exists.

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A method for charging and discharging the battery unit in the electric device according to the invention comprises the steps of discharging in order the storage battery packs of the battery units mounted on the electric device to a predetermined remaining capacity and then charging them, by referring to the
5 information stored in the memories respectively.

Alternatively, it is preferable to discharge the storage battery packs of the battery units mounted on the electric device in decreasing order of remaining capacity, and to charge them in increasing order of remaining capacity, by referring to the information stored in the memories respectively.

10 Further, it is also preferable to discharge the storage battery packs of the battery units mounted on the electric device in increasing order of remaining capacity, and to charge them when the remaining capacities become a predetermined value or less, by referring to the information stored in the memories respectively.

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What is claimed is:

1. (Canceled)

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2. (Canceled)

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3. (Canceled)

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4. (Amended) An electric device, comprising:

a plurality of battery units detachably mounted thereon, each battery unit constituted by pairing a storage battery pack with a memory for storing at least information about charge and discharge states of the storage battery pack;

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connectors provided on said each battery unit and a battery unit installation section on a device main body side, for performing electrical connection/disconnection to/from the device main body side incident to attachment/detachment of said battery unit; and

25 a driver for driving a load, a charger for charging said storage battery pack by referring to the information stored in said memory of said each mounted battery unit, and a controller for controlling supply of electric power from said each battery unit to said driver by referring to the information

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stored in said memory of said each mounted battery unit, which are provided on said device main body side,

5 wherein said charger includes means for reading at least an information about charge and discharge states of the storage battery pack stored in said memory of said each battery unit, and means for writing into said memory at least the information about charge and discharge states of said storage battery pack in the same unit.

5. An electric device, comprising:

10 a plurality of battery units detachably mounted thereon, each battery unit provided with a storage battery pack, a memory for storing at least information about charge and discharge states of the storage battery pack, and a charger for charging said storage battery pack;

15 connectors provided on said each battery unit and a battery unit installation section on a device main body side, for performing electrical connection/disconnection to/from the device main body side incident to attachment/detachment of said battery unit; and

20 a driver for driving a load and a controller for controlling supply of electric power from said each battery unit to said driver by referring to the information stored in said memory of said each mounted battery unit, which are provided on said device main body side,

wherein said charger of said each battery unit has means for deciding a charge order by mutually referring to the information stored in said memory of said each mounted battery unit.

6. (Amended) An electric device, comprising:

25 a plurality of battery units detachably mounted thereon, each battery unit provided with a storage battery pack, a memory for storing at least information about charge and discharge states of the storage battery pack, and

a switch connected to said storage battery pack in series;

connectors provided on said each battery unit and a battery unit installation section on a device main body side, for performing electrical connection/disconnection to/from the device main body side incident to attachment/detachment of said battery unit; and

a driver for driving a load, a charger for charging said storage battery pack through said switch by referring to the information stored in said memory of said each mounted battery unit, and a controller for controlling supply of electric power from said storage battery pack to said driver through said switch of said battery unit by referring to the information stored in said memory of said each mounted battery unit, which are provided on said device main body side,

wherein said charger includes means for reading at least an information about charge and discharge states of the storage battery pack stored in said memory of said each battery unit, and means for writing into said memory at least the information about charge and discharge states of said storage battery pack in the same unit.

7. An electric device according to claim 4, wherein
said charger is constituted to be a unit attachable/detachable to/from said electric device main body.

8. An electric device according to claim 6, wherein
said charger is constituted to be a unit attachable/detachable to/from said electric device main body.

9. (Canceled)

10. An electric device according to any one of claim 4 to claim 8, wherein

said controller has means for reading the information stored in said memory of said each battery unit to control action of the whole device.

5 11. An electric device according to any one of claim 4 to claim 8, wherein

said memory of said each battery unit also stores information about characteristics of said storage battery pack, and said charger has means for controlling charge of said storage battery pack, by referring to the information
10 about the characteristics of said storage battery pack stored in said memory of said each battery unit, in accordance with the characteristics.

12. An electric device according to any one of claim 4 to claim 8, wherein

said memory of said each battery unit also stores information about
15 characteristics of said storage battery pack, and said controller has means for controlling discharge from said storage battery pack, by referring to the information about the characteristics of said storage battery pack stored in said memory of said each battery unit, in accordance with the characteristics.

20 13. An electric device according to any one of claim 4 to claim 8, wherein

said controller has means for displaying a remaining capacity of said storage battery pack of said each battery unit based on the information stored in said each battery unit, and displaying a charge request and/or giving an alarm when a storage battery pack needing to be charged exists.

25 14. (Canceled)

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5 15. (Canceled)

10 16. A method for charging and discharging said battery unit in the electric device according to any one of claim 4 to claim 8, comprising the steps of:

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